

CLAIMS

1. A flow control device for controlling a flow of a fluid in a channel in which the fluid is supplied to a target where a pressure is lower than a fluid supply source, comprising:

- 5 a first opening and closing valve for opening and closing the channel;
a flow control component with a flow control valve mechanism for controlling the flow of the fluid flowing through the channel;
a pressure detector capable of detecting a pressure of the fluid on a same side as the flow control valve mechanism relative to the first opening
10 and closing valve; and
a deviation measurement/control component for calculating a deviation of the flow controlled by the flow control component from a standard level, wherein
the deviation measurement/control component
15 fixes an aperture of the flow control valve mechanism and measures changes in the pressure using the pressure detector while the channel is closed by the first opening and closing valve, and
calculates the deviation from the standard level based on the measured changes in the pressure.

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2. A flow control device in accordance with claim 1, wherein
the flow control component further comprises a flow detector capable of measuring the flow of the fluid flowing through the channel on the same side
as the flow control valve mechanism relative to the first opening and closing
25 valve, and controls the flow of the fluid flowing through the channel by adjusting the aperture of the flow control valve mechanism based on a target flow and the flow measured by the flow detector, and
the deviation measurement/control component is capable of adjusting an output level representing the flow by the flow detector based on the
30 deviation from the standard level.

3. A flow control device in accordance with claim 2, comprising
a second opening and closing valve for opening and closing the channel
on a side opposite the first opening and closing valve relative to the flow
5 detector, wherein

the deviation measurement/control component is capable of reading the
output level representing the flow by the flow detector while the channel is
closed by the first and second opening and closing valves, and adjusting an
output level representing zero flow by the detector.

10 4. A flow control device in accordance with claim 1, further comprising
a accumulator in which the fluid flowing through the channel can be
held between the first opening and closing valve and the flow control valve
mechanism.

15 5. A flow control device in accordance with claim 1, further comprising
a temperature detector capable of measuring a temperature of the fluid
on the same side as the flow control valve mechanism relative to the first
opening and closing valve, wherein

20 the deviation measurement/control component further calculates the
deviation from the standard level based on:

an initial pressure P_0 of the fluid at a first time in a certain
time interval including a time the channel is closed by the first opening and
closing valve,

25 an absolute temperature T_1 of the fluid at a second time period
in the certain time interval, and

a time period Δt from a time the pressure of the fluid reaches a
certain first standard pressure after the channel is closed by the first opening
and closing valve until a time the pressure reaches a certain second standard
30 pressure P_2 which is different from the first standard pressure P_1 .

6. A flow control device in accordance with claim 5, wherein
the deviation measurement/control component calculates the deviation
from the standard level based on a ratio between $PO/(T1 \times \Delta t)$ and a certain
5 constant related to the standard level.

7. A mass flow control device comprising a flow control component which
has in a channel through which a fluid flows: a flow detector for detecting a
mass flow of the fluid that flows through the channel and outputting a flow
10 signal; and a flow control valve mechanism for controlling the mass flow by
altering a valve aperture by means of valve drive signals, and controls the
flow control valve mechanism based on an externally input flow set signal
and the flow signal, wherein

the mass flow control device is characterized by comprising a deviation
15 measurement/control component which has in the channel: a first opening
and closing valve for opening and closing the channel; an accumulator having a
certain volume; and a pressure detector for detecting a pressure of the fluid
and outputting a pressure detection signal, and controlling the test valve and
the accumulator and the pressure detector to perform a mass flow test
20 operations.

8. A mass flow control device in accordance with claim 7, characterized in
that the deviation measurement/control component calibrates the flow
detector based on a result of the test.

9. A mass flow control device in accordance with claim 7, characterized in
that a second opening and closing valve for opening and closing an outlet side
of the channel during a zero point measurement is executed is provided in the
channel.

10. A mass flow control device in accordance with claim 7, characterized in that the first opening and closing valve, the accumulator, and the pressure detector are provided further upstream than the flow detector and the flow control valve mechanism.

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11. A mass flow control device in accordance with claim 7, characterized in that the first opening and closing valve, the accumulator, and the pressure detector are provided further downstream than the flow detector and the flow control valve mechanism.

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12. A method for adjusting a flow control device that controls a flow of a fluid in a channel in which the fluid is supplied to a target where a pressure is lower than a fluid supply source, the flow control device comprising a flow control component with a flow control valve mechanism for controlling the

15 flow of the fluid flowing through the channel,

the adjusting method comprising the steps of:

a) fixing an aperture of the flow control valve mechanism;

b) closing the channel using a first opening and closing valve;

20 c) measuring changes in a pressure of the fluid at a predetermined first position on a same side as the flow control valve mechanism relative to the first opening and closing valve after the steps a) and b);

d) calculating a deviation of the flow controlled by the flow control component from a standard level based on the measured pressure changes; and

25 e) adjusting the flow control component based on the deviation from the standard level.

13. A method in accordance with claim 12, wherein

30 the flow control component further comprises a flow detector capable of measuring the flow of the fluid flowing through the channel on the same side

as the flow control valve mechanism relative to the first opening and closing valve, and controls the flow of the fluid flowing through the channel by adjusting the aperture of the flow control valve mechanism based on a target flow and the flow measured by the flow detector,

the step e) comprising the step of adjusting an output level representing the flow by the flow detector based on the deviation from the standard level.

14. A method in accordance with claim 13, further comprising the steps of:

f) closing the channel using the first opening and closing valve, and closing the channel using a second opening and closing valve on a side opposite the first opening and closing valve relative to the flow detector;

g) reading the output level representing the flow by the flow detector while the channel is closed by the first and second opening and closing valves; and

h) adjusting an output level representing zero flow by the detector.

15. A method in accordance with claim 12, wherein

the step d) further comprises the step of

calculating the deviation from the standard level based on:

an initial pressure P_0 of the fluid in the first position at a first time in a certain time interval including a time the channel is closed by the first opening and closing valve;

an absolute temperature T_1 of the fluid in a predetermined second position on a same side as the first position relative to the first opening and closing valve at a second time in the certain time interval; and

a time period Δt from a time the pressure of the fluid reaches a first standard pressure at the first position after the channel is closed by the first opening and closing valve until a time the pressure reaches a second standard pressure P_2 which is different from the first standard pressure P_1 .

16. A method in accordance with claim 15, wherein
the step d) further comprises the step of
calculating the deviation from the standard level based on a ratio
5 between $PO/(T1 \times \Delta t)$ and a certain constant related to the standard level.

17. A method for testing a mass flow control device, wherein
the mass flow control device comprises:
a flow control component which has in a channel through which
10 a fluid flows: a flow detector for detecting a mass flow of a fluid that flows
through the channel and outputting a flow signal; and a flow control valve
mechanism for controlling the mass flow by altering a valve aperture by
means of valve drive signals, and controls the flow control valve mechanism
based on an externally input flow set signal and the flow signal; and
15 a deviation measurement/control component which has in the
channel: a first opening and closing valve for opening and closing the
channel; an accumulator having a certain volume; and a pressure detector for
detecting a pressure of the fluid and outputting a pressure detection signal,
and controls the test valve and the accumulator and the pressure detector to
20 perform a mass flow test operation, and
the testing method is characterized in comprising the steps of:
setting a verification flow;
ensuring a stable flow of a fluid for the test in the channel;
detecting a pressure of the flowing fluid and a temperature of
25 the accumulator to determine an initial pressure and an initial temperature
respectively; and
closing the channel using the first opening and closing valve;
measuring changes in a pressure of a fluid flowing from the
accumulator after the closure of the channel; and

determining a test results based on the measured pressure changes and a predetermined standard pressure change characteristic.

18. A method for testing a mass flow control device in accordance with
5 claim 17, characterized in that the flow detector is automatically calibrated based on the test results.

19. A method for testing a mass flow control device in accordance with
claim 17, characterized in that the verification flow is altered in various
10 amounts.

20. A method for testing a mass flow control device in accordance with
claim 17, characterized in that, before the step for setting the verification
flow, a step is carried out to measure a zero point by blocking the flow of the
15 fluid flowing in the channel.